

DRAINAGE REPORT

FOR

TURVEY DG PIT

May 19, 2009

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FOR REVIEW

TABLE OF CONTENTS

Introduction.....	1
Hydrologic Analyses.....	2
Conclusion	3

APPENDICES

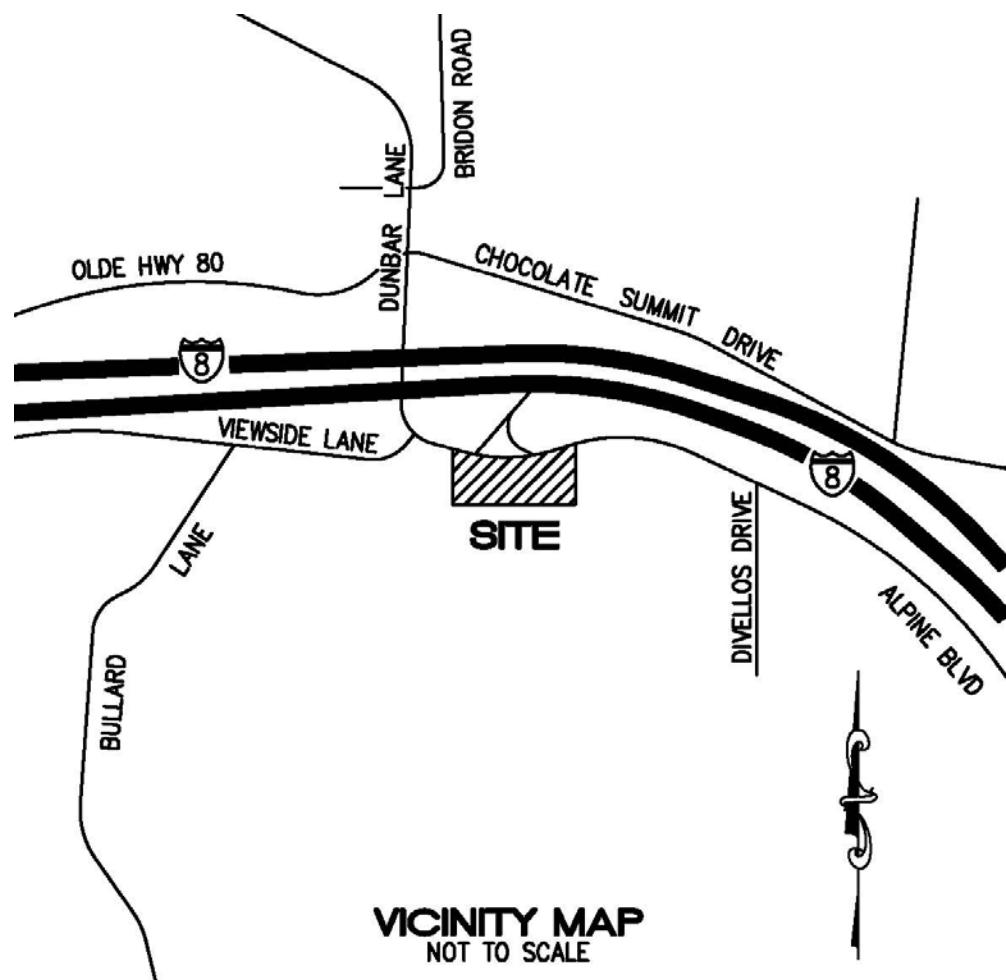
- A. 100-Year Hydrologic Analyses

FOR REVIEW

INTRODUCTION

The Turvey DG Pit project is located southeast of the intersection of Alpine Boulevard and Viewside Lane in San Diego County (see Vicinity Map). The project proposes a surface mining operation within a natural, south facing hillside. The operation will remove native materials and create reclaimed pads that are intended to be used for a wholesale box tree nursery. The current conditions include approximately four acres within the northeast portion of the site that are currently undergoing grading activities authorized by Grading Permit L-13349. This grading will be finished before the surface mining is complete.

Surface runoff flows towards the project area from the upper hillside area. The off-site runoff combines with on-site runoff and is collected by three existing drainage facilities along the northerly site boundary. This report contains existing and proposed condition drainage analyses based on the reclamation plan for the project.



HYDROLOGIC ANALYSES

Hydrologic analyses were performed for the existing and proposed conditions. The County of San Diego's 2003 *Hydrology Manual* rational method procedure was used for the 100-year hydrologic analyses. The rational method input parameters are summarized below and the supporting data is included in Appendix A:

- Precipitation: The 100-year, 6- and 24-hour precipitation values are 3.0 and 6.5 inches, respectively.
- Drainage area: The drainage basins were delineated from the County of San Diego's orthotopographic mapping, base topography prepared for the project, and the proposed reclamation plan grading. The Rational Method Work Maps in Appendix A contain the basin boundaries, rational method node numbers, and basin areas. The overall existing condition drainage basin boundary was set equal to the overall proposed condition boundary to allow a comparison of results. The existing condition analysis assumes that neither the project nor the grading allowed under Grading Permit L-13349 have occurred.
- Hydrologic soil groups: The hydrologic soil groups were determined from the Web Soil Survey. The soil groups in the study area are type B and C.
- Runoff coefficients: The existing and proposed site conditions will contain minimal impervious surfaces. Therefore, the runoff coefficients were based on the undisturbed natural terrain category.
- Flow lengths and elevations: The flow lengths and elevations were obtained from the topographic mapping and reclamation plan.

The rational method analyses were performed using the CivilDesign Rational Method Hydrology Program, which is based on the County of San Diego's 2003 *Hydrology Manual*. The existing and proposed condition output is included in Appendix A and summarized in Table 1. The existing and proposed condition study areas were subdivided into three major drainage basins. Each basin is tributary to an existing storm drain facility along the northerly property boundary. The easterly and central drainage facilities collect runoff from the site along the southerly edge of Alpine Boulevard. The westerly drainage facility collects runoff along the southerly edge of Viewside Lane.

Existing Drainage Facility	Exist. Cond. 100-Year Flow, cfs	Prop. Cond. 100-Year Flow, cfs
West	6.6	11.5
Central	12.1	1.4
East	42.8	42.5
Total	61.5	55.3

Table 1. Summary of Rational Method Results

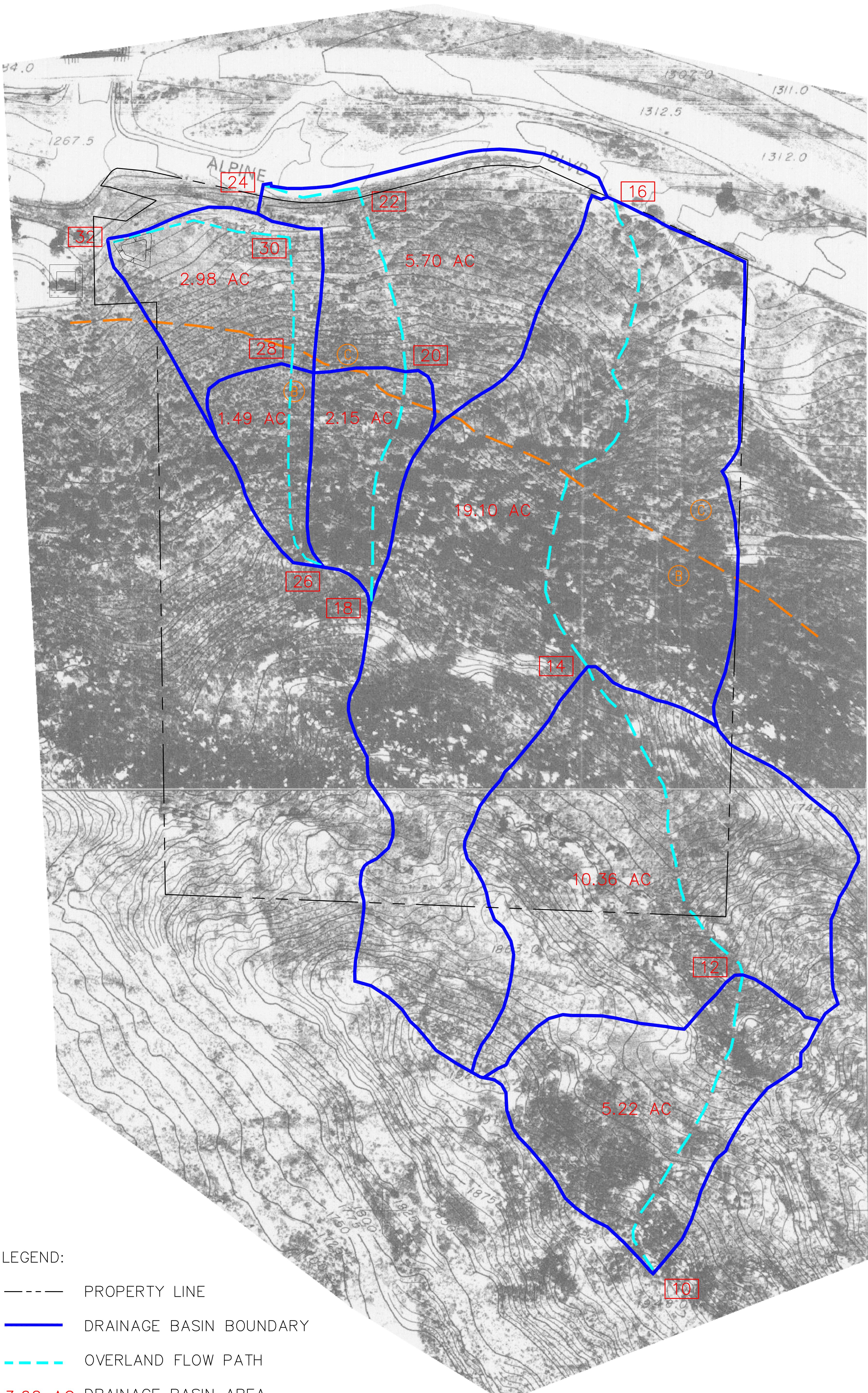
The Rational Method results indicate that the project will not increase the 100-year runoff at the central and easterly drainage facilities. However, the runoff will increase by approximately 5 cfs at the westerly facility. In order to mitigate for the increase, a detention basin is proposed near the northwest corner of the project area. An analysis of the basin was performed by converting the proposed condition rational method results into a hydrograph using the procedure outlined in the *Hydrology Manual*. The hydrograph and basin characteristics were then entered into HEC-1. The HEC-1 results are included in Appendix A. The results indicate that the proposed condition 100-year runoff will be detained to approximately 2 cfs, which is less than the existing condition runoff of 6.6 cfs.

CONCLUSION

Drainage analyses have been performed for the Turvey DG Pit project. The project proposes extractive activities, so it will not add impervious areas. The results indicate that the overall 100-year flow rate leaving the site is reduced by the project. This is likely due to the fact that the project is creating pads and adjusting flow patterns, which increase the flow length. However, the runoff towards the west will increase. In order to mitigate for this a detention basin is proposed. The results indicate that the basin will reduce the 100-year flow rate below existing levels. The water stored in the basin will be used for the on-site activities. The basin will also provide water quality benefits because it will provide storage and infiltration.

APPENDIX A

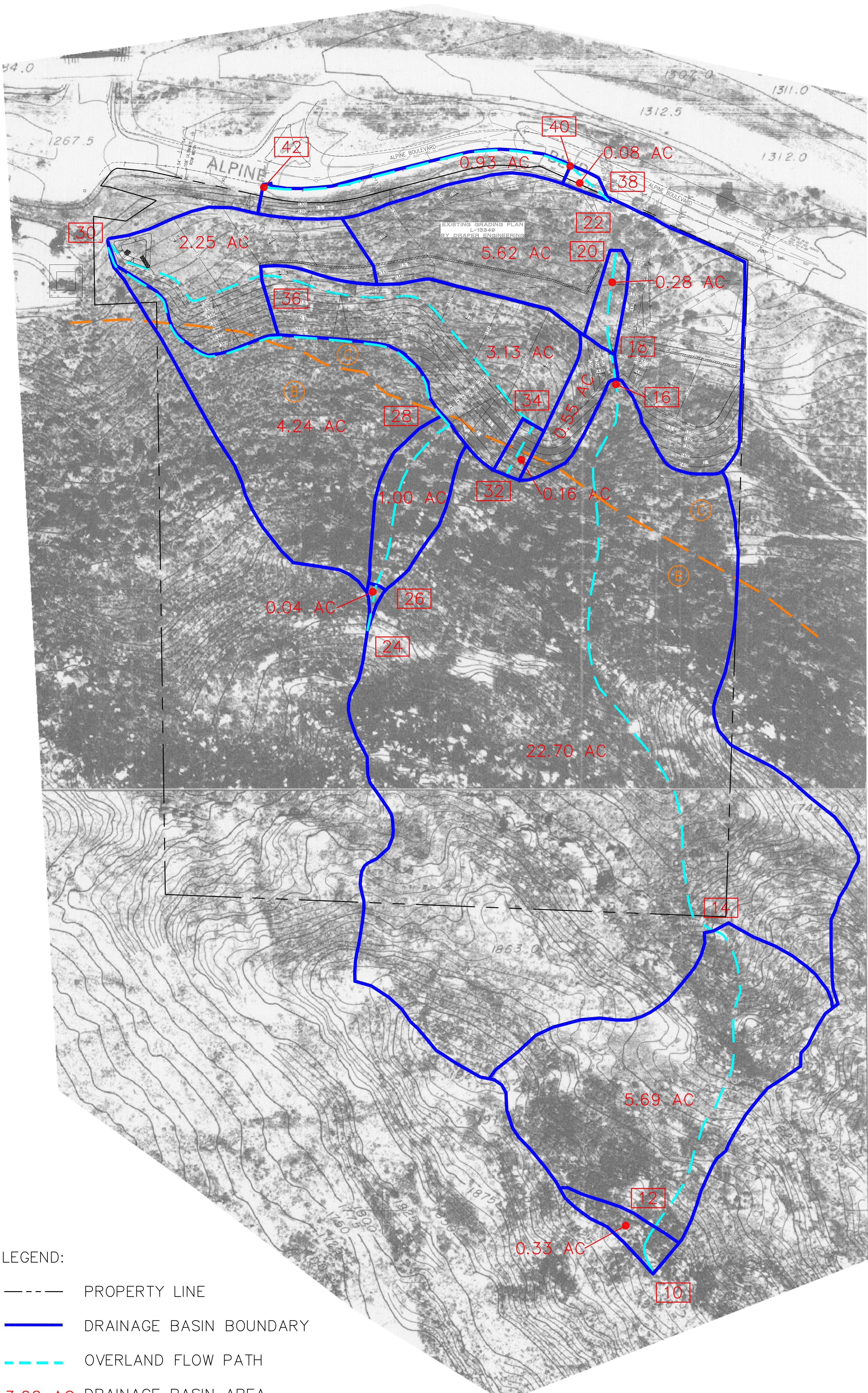
100-YEAR HYDROLOGIC ANALYSES



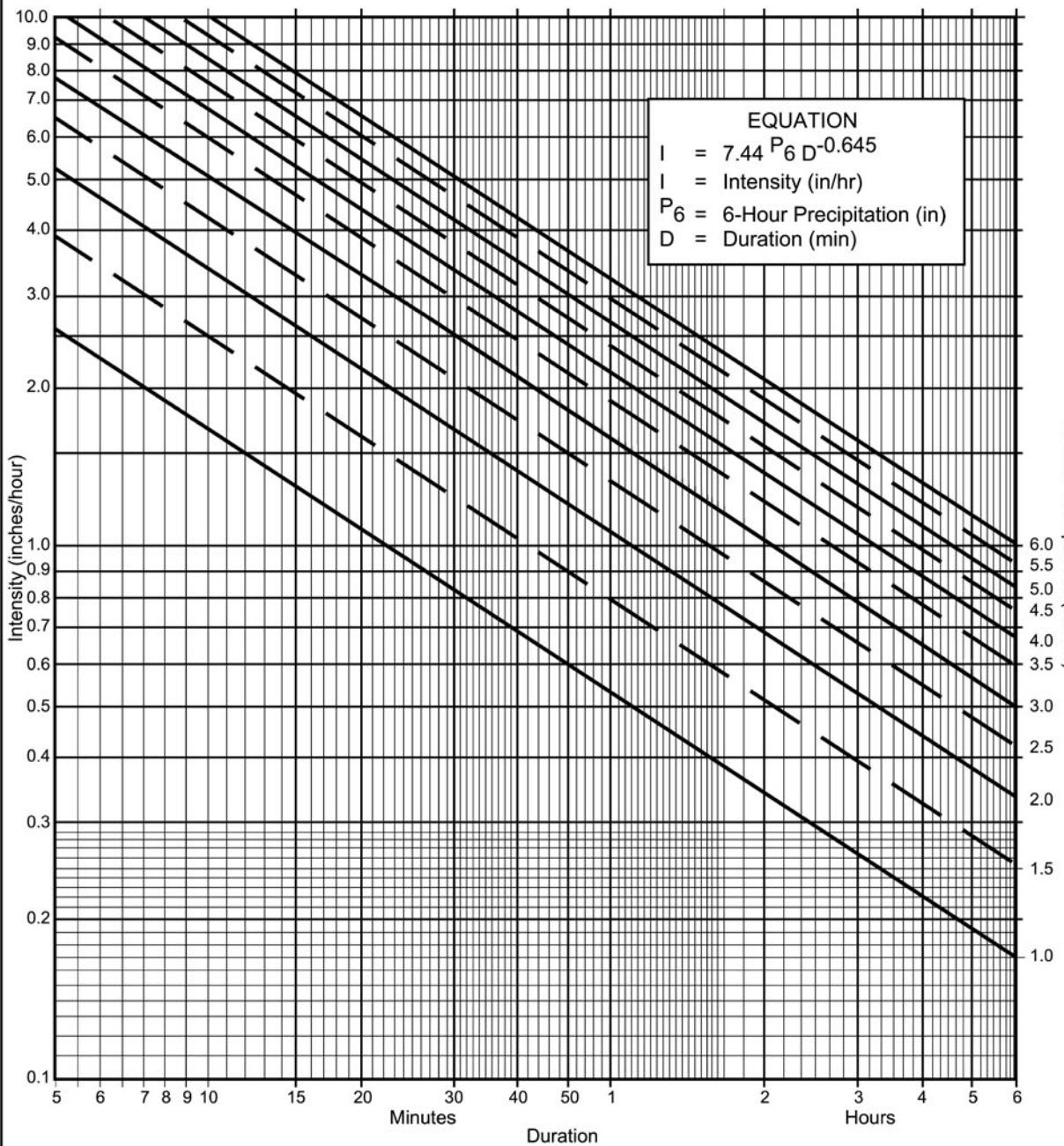
LEGEND:

- PROPERTY LINE
- DRAINAGE BASIN BOUNDARY
- - - OVERLAND FLOW PATH
- 3.62 AC DRAINAGE BASIN AREA
- [10] RATIONAL METHOD NODE NUMBER
- (D) HYDROLOGIC SOIL GROUP

EXISTING CONDITION
RATIONAL METHOD WORK MAP



PROPOSED CONDITION
RATIONAL METHOD WORK MAP



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{3.0}$ in., $P_{24} = \underline{6.5}$, $\frac{P_6}{P_{24}} = \underline{46\%}$ ⁽²⁾
- (c) Adjusted $P_6^{(2)} = \underline{3.0}$ in.
- (d) $t_x = \underline{\hspace{2cm}}$ min.
- (e) $I = \underline{\hspace{2cm}}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

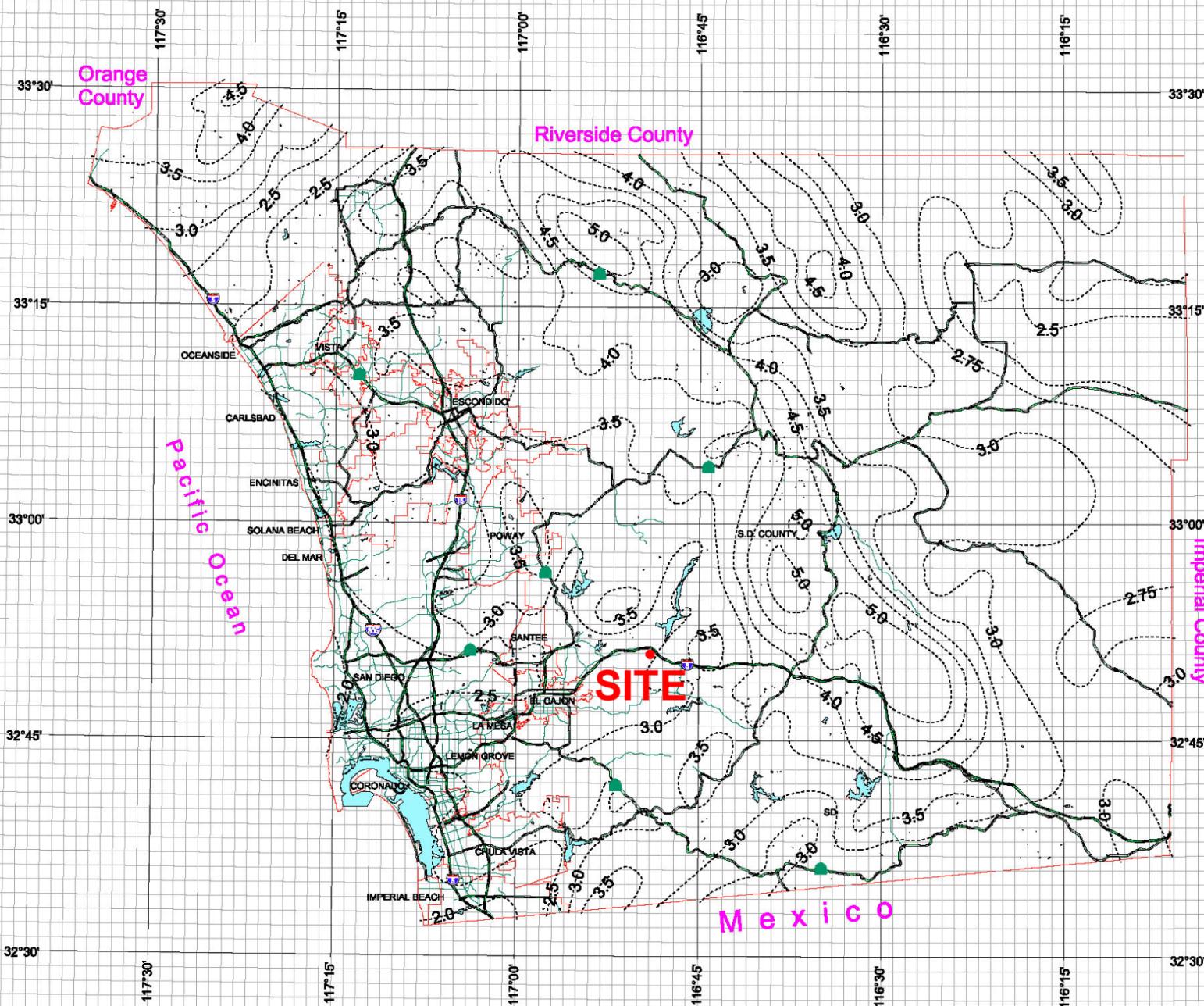
Intensity-Duration Design Chart - Template

FIGURE
3-1

County of San Diego Hydrology Manual



Rainfall Isopluvials



100 Year Rainfall Event - 6 Hours

----- Isopluvial (inches)

P6=3.0"

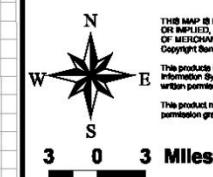
DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

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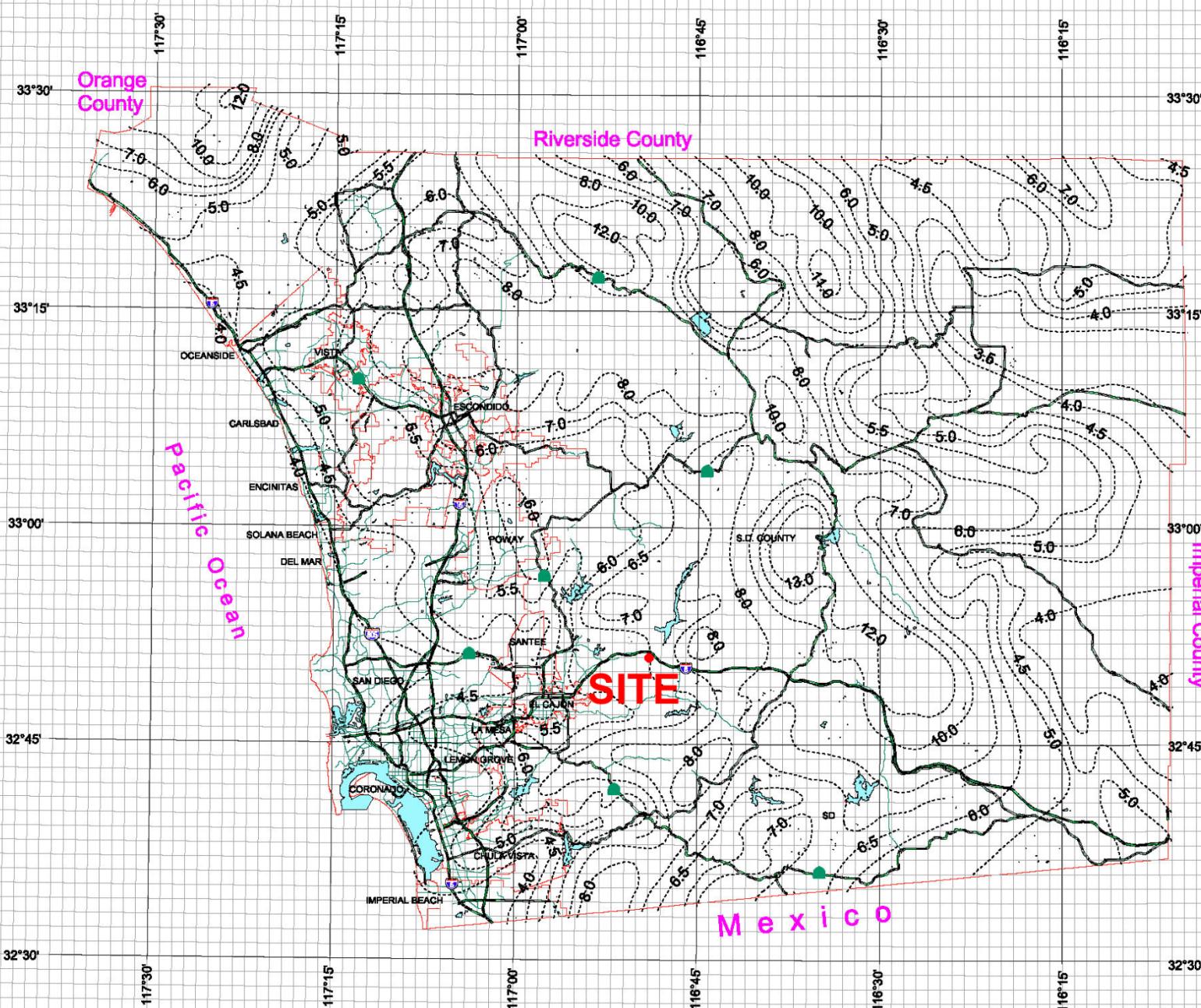
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County of San Diego Hydrology Manual



Rainfall Isopluvials



100 Year Rainfall Event - 24 Hours

----- Isopluvial (inches)

P24=6.5"



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Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

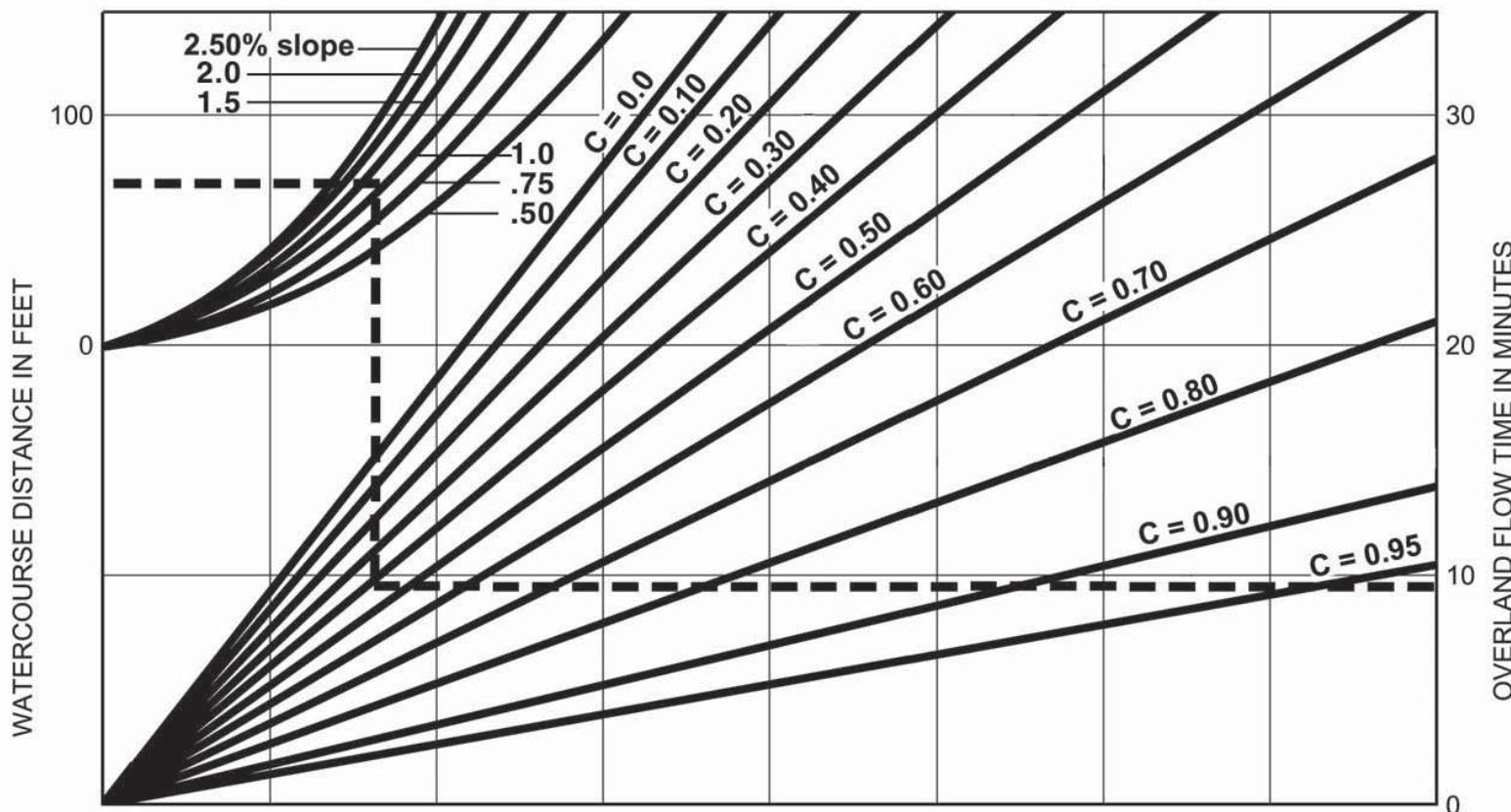
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the “Regulating Agency” when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	$L_M$	$T_i$	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
 Slope (s) = 1.3%
 Runoff Coefficient (C) = 0.41
 Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8 (1.1-C) \sqrt[3]{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

3-3

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

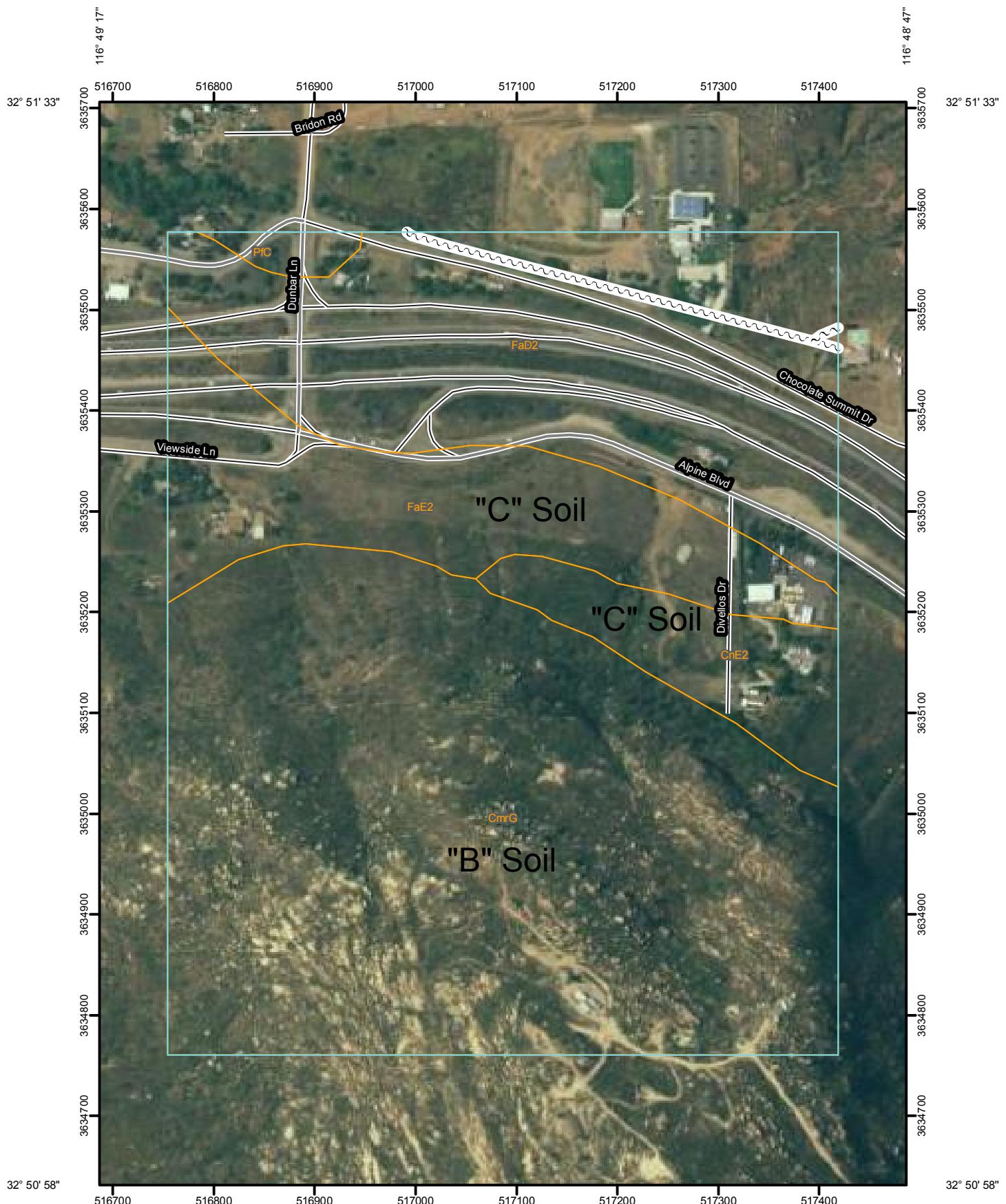
Land Use		Runoff Coefficient "C"				
NRCS Elements	County Elements	% IMPER.	Soil Type			
			A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

Soil Map—San Diego County Area, California



Map Scale: 1:5,130 if printed on A size (8.5" x 11") sheet.



Natural Resources
Conservation Service

Web Soil Survey 2.1
National Cooperative Soil Survey

1/21/2009
Page 1 of 3

MAP LEGEND

Area of Interest (AOI)	
	Area of Interest (AOI)
Soils	
	Soil Map Units
Special Point Features	
	Blowout
	Borrow Pit
	Clay Spot
	Closed Depression
	Gravel Pit
	Gravelly Spot
	Landfill
	Lava Flow
	Marsh or swamp
	Mine or Quarry
	Miscellaneous Water
	Perennial Water
	Rock Outcrop
	Saline Spot
	Sandy Spot
	Severely Eroded Spot
	Sinkhole
	Slide or Slip
	Sodic Spot
	Spoil Area
	Stony Spot

MAP INFORMATION

Map Scale: 1:5,130 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California

Survey Area Data: Version 6, Dec 17, 2007

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



Map Unit Legend

San Diego County Area, California (CA638)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	70.1	52.2%
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded	7.8	5.8%
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	36.0	26.8%
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	19.2	14.3%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slopes	1.2	0.9%
Totals for Area of Interest		134.3	100.0%



San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 02/17/09

Turvey DG Pit
Existing Conditions
100-Year Flow Rate

***** Hydrology Study Control Information *****

Program License Serial Number 4028

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.500
P6/P24 = 46.2%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 10.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Initial subarea total flow distance = 700.000(Ft.)
Highest elevation = 1942.000(Ft.)
Lowest elevation = 1765.000(Ft.)
Elevation difference = 177.000(Ft.) Slope = 25.286 %
Top of Initial Area Slope adjusted by User to 20.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 20.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 5.64 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5} / (% slope^{(1/3)})]$
 $TC = [1.8 * (1.1 - 0.2500) * (100.000^{.5}) / (20.000^{(1/3)})] = 5.64$

The initial area total distance of 700.00 (Ft.) entered leaves a remaining distance of 600.00 (Ft.)

Using Figure 3-4, the travel time for this distance is 1.83 minutes for a distance of 600.00 (Ft.) and a slope of 25.29 % with an elevation difference of 151.72(Ft.) from the end of the top area

$$Tt = [11.9 * \text{length(Mi)}^3] / (\text{elevation change(Ft.)})^{.385} * 60(\text{min/hr})$$

$$= 1.827 \text{ Minutes}$$

$$Tt = [(11.9 * 0.1136^3) / (151.72)]^{.385} = 1.83$$

Total initial area T_i = 5.64 minutes from Figure 3-3 formula plus 1.83 minutes from the Figure 3-4 formula = 7.46 minutes

Rainfall intensity (I) = 6.105(In/Hr) for a 100.0 year storm

Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.250$

Subarea runoff = 7.966(CFS)

Total initial stream area = 5.220(Ac.)

+++++
Process from Point/Station 12.000 to Point/Station 14.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1765.000(Ft.)
 Downstream point elevation = 1625.000(Ft.)
 Channel length thru subarea = 764.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 3.000
 Slope or 'Z' of right channel bank = 3.000
 Estimated mean flow rate at midpoint of channel = 14.328(CFS)
 Manning's 'N' = 0.040
 Maximum depth of channel = 5.000(Ft.)
 Flow(q) thru subarea = 14.328(CFS)
 Depth of flow = 0.343(Ft.), Average velocity = 6.938(Ft/s)
 Channel flow top width = 7.056(Ft.)
 Flow Velocity = 6.94(Ft/s)
 Travel time = 1.84 min.
 Time of concentration = 9.30 min.
 Critical depth = 0.563(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 5.297(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, A_i = 0.000
 Sub-Area C Value = 0.250
 Rainfall intensity = 5.297(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 $(Q=KCIA)$ is $C = 0.250$ CA = 3.895
 Subarea runoff = 12.667(CFS) for 10.360(Ac.)
 Total runoff = 20.634(CFS) Total area = 15.580(Ac.)
 Depth of flow = 0.421(Ft.), Average velocity = 7.814(Ft/s)
 Critical depth = 0.695(Ft.)

+++++
Process from Point/Station 14.000 to Point/Station 16.000

***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 1625.000(Ft.)
Downstream point elevation = 1306.000(Ft.)
Channel length thru subarea = 1117.000(Ft.)
Channel base width = 5.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 31.752(CFS)
Manning's 'N' = 0.040
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 31.752(CFS)
Depth of flow = 0.474(Ft.), Average velocity = 10.428(Ft/s)
Channel flow top width = 7.845(Ft.)
Flow Velocity = 10.43(Ft/s)
Travel time = 1.79 min.
Time of concentration = 11.08 min.
Critical depth = 0.891(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 4.730(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.600
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.270
Rainfall intensity = 4.730(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.261 CA = 9.052
Subarea runoff = 22.183(CFS) for 19.100(Ac.)
Total runoff = 42.817(CFS) Total area = 34.680(Ac.)
Depth of flow = 0.560(Ft.), Average velocity = 11.448(Ft/s)
Critical depth = 1.063(Ft.)

+++++
Process from Point/Station 14.000 to Point/Station 16.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 34.680(Ac.)
Runoff from this stream = 42.817(CFS)
Time of concentration = 11.08 min.
Rainfall intensity = 4.730(In/Hr)
Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 18.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.950
Decimal fraction soil group C = 0.050

Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.253
 Initial subarea total flow distance = 505.000(Ft.)
 Highest elevation = 1665.000(Ft.)
 Lowest elevation = 1400.000(Ft.)
 Elevation difference = 265.000(Ft.) Slope = 52.475 %
 Top of Initial Area Slope adjusted by User to 30.000 %
 Bottom of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 100.00 (Ft)
 for the top area slope value of 30.00 %, in a development type of
 Permanent Open Space
 In Accordance With Figure 3-3
 Initial Area Time of Concentration = 4.91 minutes
 $TC = [1.8 * (1.1 - C) * \text{distance}(\text{Ft.})^{0.5}] / (\% \text{slope}^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.2525) * (100.000^{0.5})] / (30.000^{(1/3)}) = 4.91$
 The initial area total distance of 505.00 (Ft.) entered leaves a
 remaining distance of 405.00 (Ft.)
 Using Figure 3-4, the travel time for this distance is 1.26 minutes
 for a distance of 405.00 (Ft.) and a slope of 30.00 %
 with an elevation difference of 121.50(Ft.) from the end of the top area
 $Tt = [11.9 * \text{length}(\text{Mi})^3] / (\text{elevation change}(\text{Ft.}))^{0.385} * 60(\text{min/hr})$
 = 1.264 Minutes
 $Tt = [(11.9 * 0.0767^3) / (121.50)]^{0.385} = 1.26$
 Total initial area Ti = 4.91 minutes from Figure 3-3 formula plus
 1.26 minutes from the Figure 3-4 formula = 6.17 minutes
 Rainfall intensity (I) = 6.899(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.253
 Subarea runoff = 3.746(CFS)
 Total initial stream area = 2.150(Ac.)

++++++
 Process from Point/Station 20.000 to Point/Station 22.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1400.000(Ft.)
 Downstream point elevation = 1290.000(Ft.)
 Channel length thru subarea = 405.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 20.000
 Slope or 'Z' of right channel bank = 20.000
 Manning's 'N' = 0.040
 Maximum depth of channel = 3.000(Ft.)
 Flow(q) thru subarea = 3.746(CFS)
 Depth of flow = 0.125(Ft.), Average velocity = 3.994(Ft/s)
 Channel flow top width = 10.001(Ft.)
 Flow Velocity = 3.99(Ft/s)
 Travel time = 1.69 min.
 Time of concentration = 7.86 min.
 Critical depth = 0.199(Ft.)

++++++

Process from Point/Station 22.000 to Point/Station 24.000
***** IMPROVED CHANNEL TRAVEL TIME *****

Upstream point elevation = 1290.000(Ft.)
Downstream point elevation = 1285.000(Ft.)
Channel length thru subarea = 209.000(Ft.)
Channel base width = 30.000(Ft.)
Slope or 'Z' of left channel bank = 2.000
Slope or 'Z' of right channel bank = 50.000
Estimated mean flow rate at midpoint of channel = 7.937(CFS)
Manning's 'N' = 0.016
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 7.937(CFS)
Depth of flow = 0.090(Ft.), Average velocity = 2.743(Ft/s)
Channel flow top width = 34.654(Ft.)
Flow Velocity = 2.74(Ft/s)
Travel time = 1.27 min.
Time of concentration = 9.13 min.
Critical depth = 0.125(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 5.359(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Rainfall intensity = 5.359(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.287 CA = 2.253
Subarea runoff = 8.328(CFS) for 5.700(Ac.)
Total runoff = 12.074(CFS) Total area = 7.850(Ac.)
Depth of flow = 0.115(Ft.), Average velocity = 3.197(Ft/s)
Critical depth = 0.164(Ft.)

++++++
Process from Point/Station 22.000 to Point/Station 24.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 7.850(Ac.)
Runoff from this stream = 12.074(CFS)
Time of concentration = 9.13 min.
Rainfall intensity = 5.359(In/Hr)
Program is now starting with Main Stream No. 3

++++++
Process from Point/Station 26.000 to Point/Station 28.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000

Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.250
 Initial subarea total flow distance = 455.000(Ft.)
 Highest elevation = 1640.000(Ft.)
 Lowest elevation = 1400.000(Ft.)
 Elevation difference = 240.000(Ft.) Slope = 52.747 %
 Top of Initial Area Slope adjusted by User to 30.000 %
 Bottom of Initial Area Slope adjusted by User to 30.000 %
 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 100.00 (Ft)
 for the top area slope value of 30.00 %, in a development type of
 Permanent Open Space
 In Accordance With Figure 3-3
 Initial Area Time of Concentration = 4.92 minutes

$$TC = [1.8 * (1.1 - C) * distance(Ft.)^{0.5}] / (% slope^{(1/3)})$$

$$TC = [1.8 * (1.1 - 0.2500) * (100.000^{0.5})] / (30.000^{(1/3)}) = 4.92$$

 The initial area total distance of 455.00 (Ft.) entered leaves a
 remaining distance of 355.00 (Ft.)
 Using Figure 3-4, the travel time for this distance is 1.14 minutes
 for a distance of 355.00 (Ft.) and a slope of 30.00 %
 with an elevation difference of 106.50(Ft.) from the end of the top area

$$Tt = [11.9 * length(Mi)^3] / (elevation change(Ft.))^{0.385} * 60(min/hr)$$

 = 1.142 Minutes

$$Tt = [(11.9 * 0.0672^3) / (106.50)]^{0.385} = 1.14$$

 Total initial area Ti = 4.92 minutes from Figure 3-3 formula plus
 1.14 minutes from the Figure 3-4 formula = 6.07 minutes
 Rainfall intensity (I) = 6.978(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.250
 Subarea runoff = 2.599(CFS)
 Total initial stream area = 1.490(Ac.)

++++++
 Process from Point/Station 28.000 to Point/Station 30.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1400.000(Ft.)
 Downstream point elevation = 1329.000(Ft.)
 Channel length thru subarea = 276.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 20.000
 Slope or 'Z' of right channel bank = 20.000
 Manning's 'N' = 0.040
 Maximum depth of channel = 1.000(Ft.)
 Flow(q) thru subarea = 2.599(CFS)
 Depth of flow = 0.104(Ft.), Average velocity = 3.515(Ft/s)
 Channel flow top width = 9.174(Ft.)
 Flow Velocity = 3.51(Ft/s)
 Travel time = 1.31 min.
 Time of concentration = 7.37 min.
 Critical depth = 0.162(Ft.)

++++++
Process from Point/Station 30.000 to Point/Station 32.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1329.000(Ft.)
Downstream point elevation = 1306.000(Ft.)
Channel length thru subarea = 387.000(Ft.)
Channel base width = 3.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 4.630(CFS)
Manning's 'N' = 0.040
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 4.630(CFS)
Depth of flow = 0.322(Ft.), Average velocity = 3.627(Ft/s)
Channel flow top width = 4.931(Ft.)
Flow Velocity = 3.63(Ft/s)
Travel time = 1.78 min.
Time of concentration = 9.15 min.
Critical depth = 0.367(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 5.352(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.250
Decimal fraction soil group C = 0.750
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.287
Rainfall intensity = 5.352(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.275 CA = 1.229
Subarea runoff = 3.979(CFS) for 2.980(Ac.)
Total runoff = 6.579(CFS) Total area = 4.470(Ac.)
Depth of flow = 0.390(Ft.), Average velocity = 4.039(Ft/s)
Critical depth = 0.453(Ft.)

++++++
Process from Point/Station 28.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 3
Stream flow area = 4.470(Ac.)
Runoff from this stream = 6.579(CFS)
Time of concentration = 9.15 min.
Rainfall intensity = 5.352(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	42.817	11.08	4.730
2	12.074	9.13	5.359

3	6.579	9.15	5.352		
Qmax(1) =					
	1.000 *	1.000 *	42.817)	+	
	0.883 *	1.000 *	12.074)	+	
	0.884 *	1.000 *	6.579)	+ =	59.288
Qmax(2) =					
	1.000 *	0.824 *	42.817)	+	
	1.000 *	1.000 *	12.074)	+	
	1.000 *	0.998 *	6.579)	+ =	53.919
Qmax(3) =					
	1.000 *	0.826 *	42.817)	+	
	0.999 *	1.000 *	12.074)	+	
	1.000 *	1.000 *	6.579)	+ =	53.992

Total of 3 main streams to confluence:

Flow rates before confluence point:

42.817	12.074	6.579
--------	--------	-------

Maximum flow rates at confluence using above data:

59.288	53.919	53.992
--------	--------	--------

Area of streams before confluence:

34.680	7.850	4.470
--------	-------	-------

Results of confluence:

Total flow rate = 59.288(CFS)

Time of concentration = 11.084 min.

Effective stream area after confluence = 47.000(Ac.)

End of computations, total study area = 47.000 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 05/19/09

Turvey DG Pit
Proposed Conditions
100-Year Flow Rate

***** Hydrology Study Control Information *****

Program License Serial Number 4028

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.500
P6/P24 = 46.2%
San Diego hydrology manual 'C' values used

+++++
Process from Point/Station 10.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Initial subarea total flow distance = 109.000(Ft.)
Highest elevation = 1942.000(Ft.)
Lowest elevation = 1920.000(Ft.)
Elevation difference = 22.000(Ft.) Slope = 20.183 %
Top of Initial Area Slope adjusted by User to 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 15.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.20 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))
TC = [1.8*(1.1-0.2500)*(100.000^.5)/(15.000^(1/3))]= 6.20
The initial area total distance of 109.00 (Ft.) entered leaves a

remaining distance of 9.00 (Ft.)
 Using Figure 3-4, the travel time for this distance is 0.08 minutes
 for a distance of 9.00 (Ft.) and a slope of 20.18 %
 with an elevation difference of 1.82(Ft.) from the end of the top area
 $T_t = [11.9 * \text{length}(Mi)^3] / (\text{elevation change}(Ft.))^{.385} * 60(\text{min/hr})$
 = 0.079 Minutes
 $T_t = [(11.9 * 0.0017^3) / (1.82)]^{.385} = 0.08$
 Total initial area $T_i = 6.20$ minutes from Figure 3-3 formula plus
 0.08 minutes from the Figure 3-4 formula = 6.28 minutes
 Rainfall intensity (I) = 6.822(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area ($Q=KCIA$) is $C = 0.250$
 Subarea runoff = 0.563(CFS)
 Total initial stream area = 0.330(Ac.)

++++++
 Process from Point/Station 12.000 to Point/Station 14.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1920.000(Ft.)
 Downstream point elevation = 1750.000(Ft.)
 Channel length thru subarea = 698.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 3.000
 Slope or 'Z' of right channel bank = 3.000
 Estimated mean flow rate at midpoint of channel = 4.522(CFS)
 Manning's 'N' = 0.040
 Maximum depth of channel = 5.000(Ft.)
 Flow(q) thru subarea = 4.522(CFS)
 Depth of flow = 0.161(Ft.), Average velocity = 5.108(Ft/s)
 Channel flow top width = 5.969(Ft.)
 Flow Velocity = 5.11(Ft/s)
 Travel time = 2.28 min.
 Time of concentration = 8.56 min.
 Critical depth = 0.277(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 5.588(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, $A_i = 0.000$
 Sub-Area C Value = 0.250
 Rainfall intensity = 5.588(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 $(Q=KCIA)$ is $C = 0.250$ CA = 1.505
 Subarea runoff = 7.847(CFS) for 5.690(Ac.)
 Total runoff = 8.410(CFS) Total area = 6.020(Ac.)
 Depth of flow = 0.232(Ft.), Average velocity = 6.362(Ft/s)
 Critical depth = 0.406(Ft.)

++++++
 Process from Point/Station 14.000 to Point/Station 16.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1750.000(Ft.)
Downstream point elevation = 1360.000(Ft.)
Channel length thru subarea = 1279.000(Ft.)
Channel base width = 5.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 21.636(CFS)
Manning's 'N' = 0.040
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 21.636(CFS)
Depth of flow = 0.375(Ft.), Average velocity = 9.426(Ft/s)
Channel flow top width = 7.249(Ft.)
Flow Velocity = 9.43(Ft/s)
Travel time = 2.26 min.
Time of concentration = 10.82 min.
Critical depth = 0.719(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 4.804(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.950
Decimal fraction soil group C = 0.050
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.253
Rainfall intensity = 4.804(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.252 CA = 7.237
Subarea runoff = 26.353(CFS) for 22.700(Ac.)
Total runoff = 34.763(CFS) Total area = 28.720(Ac.)
Depth of flow = 0.490(Ft.), Average velocity = 10.974(Ft/s)
Critical depth = 0.938(Ft.)

Process from Point/Station 16.000 to Point/Station 18.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1360.000(Ft.)
Downstream point elevation = 1350.000(Ft.)
Channel length thru subarea = 58.000(Ft.)
Channel base width = 5.000(Ft.)
Slope or 'Z' of left channel bank = 7.000
Slope or 'Z' of right channel bank = 7.000
Estimated mean flow rate at midpoint of channel = 35.062(CFS)
Manning's 'N' = 0.040
Maximum depth of channel = 5.000(Ft.)
Flow(q) thru subarea = 35.062(CFS)
Depth of flow = 0.518(Ft.), Average velocity = 7.844(Ft/s)
Channel flow top width = 12.254(Ft.)
Flow Velocity = 7.84(Ft/s)
Travel time = 0.12 min.
Time of concentration = 10.94 min.
Critical depth = 0.805(Ft.)
Adding area flow to channel

Rainfall intensity (I) = 4.769(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.050
 Decimal fraction soil group C = 0.950
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.297
 Rainfall intensity = 4.769(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.253 CA = 7.400
 Subarea runoff = 0.527(CFS) for 0.550(Ac.)
 Total runoff = 35.291(CFS) Total area = 29.270(Ac.)
 Depth of flow = 0.520(Ft.), Average velocity = 7.858(Ft/s)
 Critical depth = 0.805(Ft.)

++++++
 Process from Point/Station 18.000 to Point/Station 20.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1350.000(Ft.)
 Downstream point elevation = 1318.000(Ft.)
 Channel length thru subarea = 215.000(Ft.)
 Channel base width = 5.000(Ft.)
 Slope or 'Z' of left channel bank = 3.000
 Slope or 'Z' of right channel bank = 3.000
 Estimated mean flow rate at midpoint of channel = 35.333(CFS)
 Manning's 'N' = 0.045
 Maximum depth of channel = 5.000(Ft.)
 Flow(q) thru subarea = 35.333(CFS)
 Depth of flow = 0.643(Ft.), Average velocity = 7.932(Ft/s)
 Channel flow top width = 8.857(Ft.)
 Flow Velocity = 7.93(Ft/s)
 Travel time = 0.45 min.
 Time of concentration = 11.40 min.
 Critical depth = 0.953(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 4.646(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 1.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.300
 The area added to the existing stream causes a
 a lower flow rate of Q = 34.772(CFS)
 therefore the upstream flow rate of Q = 35.291(CFS) is being used
 Rainfall intensity = 4.646(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.253 CA = 7.484
 Subarea runoff = 0.000(CFS) for 0.280(Ac.)
 Total runoff = 35.291(CFS) Total area = 29.550(Ac.)
 Depth of flow = 0.642(Ft.), Average velocity = 7.930(Ft/s)

Critical depth = 0.953(Ft.)

+++++
Process from Point/Station 20.000 to Point/Station 22.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1313.000(Ft.)
Downstream point/station elevation = 1312.000(Ft.)
Pipe length = 48.00(Ft.) Slope = 0.0208 Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 35.291(CFS)
Nearest computed pipe diameter = 27.00(In.)
Calculated individual pipe flow = 35.291(CFS)
Normal flow depth in pipe = 18.09(In.)
Flow top width inside pipe = 25.39(In.)
Critical Depth = 24.19(In.)
Pipe flow velocity = 12.46(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 11.46 min.

+++++
Process from Point/Station 20.000 to Point/Station 22.000
**** SUBAREA FLOW ADDITION ****

Rainfall intensity (I) = 4.629(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Time of concentration = 11.46 min.
Rainfall intensity = 4.629(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.261 CA = 9.170
Subarea runoff = 7.161(CFS) for 5.620(Ac.)
Total runoff = 42.451(CFS) Total area = 35.170(Ac.)

+++++
Process from Point/Station 20.000 to Point/Station 22.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 35.170(Ac.)
Runoff from this stream = 42.451(CFS)
Time of concentration = 11.46 min.
Rainfall intensity = 4.629(In/Hr)
Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 24.000 to Point/Station 26.000

***** INITIAL AREA EVALUATION *****

```

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN ]  

(Permanent Open Space )  

Impervious value, Ai = 0.000  

Sub-Area C Value = 0.250  

Initial subarea total flow distance = 100.000(Ft.)  

Highest elevation = 1685.000(Ft.)  

Lowest elevation = 1660.000(Ft.)  

Elevation difference = 25.000(Ft.) Slope = 25.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:  

The maximum overland flow distance is 100.00 (Ft)  

for the top area slope value of 25.00 %, in a development type of  

Permanent Open Space  

In Accordance With Figure 3-3  

Initial Area Time of Concentration = 5.23 minutes  

TC = [1.8*(1.1-C)*distance(Ft.)^.5]/(% slope^(1/3))  

TC = [1.8*(1.1-0.2500)*( 100.000^.5)/( 25.000^(1/3))] = 5.23  

Rainfall intensity (I) = 7.676(In/Hr) for a 100.0 year storm  

Effective runoff coefficient used for area (Q=KCIA) is C = 0.250  

Subarea runoff = 0.077(CFS)  

Total initial stream area = 0.040(Ac.)

```

Process from Point/Station 26.000 to Point/Station 28.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1660.000(Ft.)
 Downstream point elevation = 1431.000(Ft.)
 Channel length thru subarea = 389.000(Ft.)
 Channel base width = 10.000(Ft.)
 Slope or 'Z' of left channel bank = 20.000
 Slope or 'Z' of right channel bank = 20.000
 Estimated mean flow rate at midpoint of channel = 0.849(CFS)
 Manning's 'N' = 0.040
 Maximum depth of channel = 1.000(Ft.)
 Flow(q) thru subarea = 0.849(CFS)
 Depth of flow = 0.030(Ft.), Average velocity = 2.659(Ft/s)
 Channel flow top width = 11.205(Ft.)
 Flow Velocity = 2.66(Ft/s)
 Travel time = 2.44 min.
 Time of concentration = 7.67 min.
 Critical depth = 0.059(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 5.998(In/Hr) for a 100.0 year sto
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000

Sub-Area C Value = 0.250
Rainfall intensity = 5.998(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.250 CA = 0.260
Subarea runoff = 1.483(CFS) for 1.000(Ac.)
Total runoff = 1.559(CFS) Total area = 1.040(Ac.)
Depth of flow = 0.043(Ft.), Average velocity = 3.330(Ft/s)
Critical depth = 0.086(Ft.)

++++++
Process from Point/Station 28.000 to Point/Station 30.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1431.000(Ft.)
Downstream point elevation = 1313.000(Ft.)
Channel length thru subarea = 945.000(Ft.)
Channel base width = 0.500(Ft.)
Slope or 'Z' of left channel bank = 2.000
Slope or 'Z' of right channel bank = 2.000
Estimated mean flow rate at midpoint of channel = 4.378(CFS)
Manning's 'N' = 0.018
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 4.378(CFS)
Depth of flow = 0.355(Ft.), Average velocity = 10.174(Ft/s)
Channel flow top width = 1.922(Ft.)
Flow Velocity = 10.17(Ft/s)
Travel time = 1.55 min.
Time of concentration = 9.22 min.
Critical depth = 0.672(Ft.)
Adding area flow to channel
Rainfall intensity (I) = 5.327(In/Hr) for a 100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.900
Decimal fraction soil group C = 0.100
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.255
Rainfall intensity = 5.327(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.254 CA = 1.341
Subarea runoff = 5.585(CFS) for 4.240(Ac.)
Total runoff = 7.145(CFS) Total area = 5.280(Ac.)
Depth of flow = 0.445(Ft.), Average velocity = 11.533(Ft/s)
Critical depth = 0.836(Ft.)

++++++
Process from Point/Station 28.000 to Point/Station 30.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 1
Stream flow area = 5.280(Ac.)
Runoff from this stream = 7.145(CFS)
Time of concentration = 9.22 min.

Rainfall intensity = 5.327 (In/Hr)

+++++
Process from Point/Station 32.000 to Point/Station 34.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.500
Decimal fraction soil group C = 0.500
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.275
Initial subarea total flow distance = 119.000(Ft.)
Highest elevation = 1432.000(Ft.)
Lowest elevation = 1357.000(Ft.)
Elevation difference = 75.000(Ft.) Slope = 63.025 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 30.00 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.78 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5}] / (% slope^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.275) * (100.000^{.5}) / (30.000^{(1/3)})] = 4.78$
The initial area total distance of 119.00 (Ft.) entered leaves a
remaining distance of 19.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.12 minutes
for a distance of 19.00 (Ft.) and a slope of 30.00 %
with an elevation difference of 5.70(Ft.) from the end of the top area
 $Tt = [11.9 * length(Mi)^3] / (elevation change(Ft.))^{.385} * 60(min/hr)$
= 0.120 Minutes
 $Tt = [(11.9 * 0.0036^{.3}) / (5.70)]^{.385} = 0.12$
Total initial area Ti = 4.78 minutes from Figure 3-3 formula plus
0.12 minutes from the Figure 3-4 formula = 4.90 minutes
Calculated TC of 4.899 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 7.904 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.275
Subarea runoff = 0.348(CFS)
Total initial stream area = 0.160(Ac.)

+++++
Process from Point/Station 34.000 to Point/Station 36.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1357.000(Ft.)
Downstream point elevation = 1318.000(Ft.)
Channel length thru subarea = 710.000(Ft.)
Channel base width = 1.000(Ft.)
Slope or 'Z' of left channel bank = 1.500
Slope or 'Z' of right channel bank = 50.000

Estimated mean flow rate at midpoint of channel = 2.545(CFS)
 Manning's 'N' = 0.040
 Maximum depth of channel = 1.000(Ft.)
 Flow(q) thru subarea = 2.545(CFS)
 Depth of flow = 0.204(Ft.), Average velocity = 2.000(Ft/s)
 Channel flow top width = 11.491(Ft.)
 Flow Velocity = 2.00(Ft/s)
 Travel time = 5.92 min.
 Time of concentration = 10.82 min.
 Critical depth = 0.209(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 4.806(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.050
 Decimal fraction soil group C = 0.950
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.297
 Rainfall intensity = 4.806(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.296 CA = 0.975
 Subarea runoff = 4.338(CFS) for 3.130(Ac.)
 Total runoff = 4.686(CFS) Total area = 3.290(Ac.)
 Depth of flow = 0.261(Ft.), Average velocity = 2.332(Ft/s)
 Critical depth = 0.271(Ft.)

++++++
 Process from Point/Station 36.000 to Point/Station 30.000
 **** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1318.000(Ft.)
 Downstream point elevation = 1313.000(Ft.)
 Channel length thru subarea = 381.000(Ft.)
 Channel base width = 1.000(Ft.)
 Slope or 'Z' of left channel bank = 1.500
 Slope or 'Z' of right channel bank = 50.000
 Estimated mean flow rate at midpoint of channel = 5.521(CFS)
 Manning's 'N' = 0.040
 Maximum depth of channel = 1.000(Ft.)
 Flow(q) thru subarea = 5.521(CFS)
 Depth of flow = 0.370(Ft.), Average velocity = 1.421(Ft/s)
 Channel flow top width = 20.032(Ft.)
 Flow Velocity = 1.42(Ft/s)
 Travel time = 4.47 min.
 Time of concentration = 15.28 min.
 Critical depth = 0.291(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 3.845(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.100
 Decimal fraction soil group C = 0.900
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)

Impervious value, $A_i = 0.000$
 Sub-Area C Value = 0.295
 Rainfall intensity = 3.845 (In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 $(Q=KCIA)$ is $C = 0.296$ CA = 1.639
 Subarea runoff = 1.615 (CFS) for 2.250 (Ac.)
 Total runoff = 6.301 (CFS) Total area = 5.540 (Ac.)
 Depth of flow = 0.389 (Ft.), Average velocity = 1.469 (Ft/s)
 Critical depth = 0.309 (Ft.)

++++++
 Process from Point/Station 36.000 to Point/Station 30.000
 **** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 2
 Stream flow area = 5.540 (Ac.)
 Runoff from this stream = 6.301 (CFS)
 Time of concentration = 15.28 min.
 Rainfall intensity = 3.845 (In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	7.145	9.22	5.327
2	6.301	15.28	3.845
$Q_{max}(1) =$			
1.000 * 1.000 *	7.145) +		
1.000 * 0.603 *	6.301) + =	10.945	
$Q_{max}(2) =$			
0.722 * 1.000 *	7.145) +		
1.000 * 1.000 *	6.301) + =	11.457	

Total of 2 streams to confluence:
 Flow rates before confluence point:
 7.145 6.301
 Maximum flow rates at confluence using above data:
 10.945 11.457
 Area of streams before confluence:
 5.280 5.540
 Results of confluence:
 Total flow rate = 11.457 (CFS)
 Time of concentration = 15.285 min.
 Effective stream area after confluence = 10.820 (Ac.)

++++++
 Process from Point/Station 30.000 to Point/Station 30.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 2
 Stream flow area = 10.820 (Ac.)
 Runoff from this stream = 11.457 (CFS)
 Time of concentration = 15.28 min.

Rainfall intensity = 3.845 (In/Hr)
Program is now starting with Main Stream No. 3

+++++
Process from Point/Station 38.000 to Point/Station 40.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance = 112.000(Ft.)
Highest elevation = 1314.000(Ft.)
Lowest elevation = 1304.000(Ft.)
Elevation difference = 10.000(Ft.) Slope = 8.929 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 8.93 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.94 minutes
 $TC = [1.8 * (1.1 - C) * distance(Ft.)^{.5}] / (% slope^{(1/3)})$
 $TC = [1.8 * (1.1 - 0.300) * (100.000^{.5})] / (8.929^{(1/3)}) = 6.94$
The initial area total distance of 112.00 (Ft.) entered leaves a
remaining distance of 12.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 0.13 minutes
for a distance of 12.00 (Ft.) and a slope of 8.93 %
with an elevation difference of 1.07(Ft.) from the end of the top area
 $Tt = [11.9 * length(Mi)^3] / (elevation change(Ft.))^{.385} * 60(min/hr)$
= 0.134 Minutes
 $Tt = [(11.9 * 0.0023^3) / (1.07)]^{.385} = 0.13$
Total initial area Ti = 6.94 minutes from Figure 3-3 formula plus
0.13 minutes from the Figure 3-4 formula = 7.08 minutes
Rainfall intensity (I) = 6.318 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff = 0.152(CFS)
Total initial stream area = 0.080(Ac.)

+++++
Process from Point/Station 40.000 to Point/Station 42.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1304.000(Ft.)
Downstream point elevation = 1285.000(Ft.)
Channel length thru subarea = 671.000(Ft.)
Channel base width = 1.000(Ft.)
Slope or 'Z' of left channel bank = 1.000
Slope or 'Z' of right channel bank = 50.000
Estimated mean flow rate at midpoint of channel = 0.798(CFS)
Manning's 'N' = 0.016
Maximum depth of channel = 0.500(Ft.)

Flow(q) thru subarea = 0.798(CFS)
 Depth of flow = 0.098(Ft.), Average velocity = 2.313(Ft/s)
 Channel flow top width = 6.015(Ft.)
 Flow Velocity = 2.31(Ft/s)
 Travel time = 4.83 min.
 Time of concentration = 11.91 min.
 Critical depth = 0.125(Ft.)
 Adding area flow to channel
 Rainfall intensity (I) = 4.516(In/Hr) for a 100.0 year storm
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 1.000
 Decimal fraction soil group D = 0.000
 [UNDISTURBED NATURAL TERRAIN]
 (Permanent Open Space)
 Impervious value, Ai = 0.000
 Sub-Area C Value = 0.300
 Rainfall intensity = 4.516(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for total area
 (Q=KCIA) is C = 0.300 CA = 0.303
 Subarea runoff = 1.217(CFS) for 0.930(Ac.)
 Total runoff = 1.368(CFS) Total area = 1.010(Ac.)
 Depth of flow = 0.124(Ft.), Average velocity = 2.653(Ft/s)
 Critical depth = 0.160(Ft.)

++++++
 Process from Point/Station 40.000 to Point/Station 42.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 3
 Stream flow area = 1.010(Ac.)
 Runoff from this stream = 1.368(CFS)
 Time of concentration = 11.91 min.
 Rainfall intensity = 4.516(In/Hr)
 Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	42.451	11.46	4.629
2	11.457	15.28	3.845
3	1.368	11.91	4.516
Qmax(1) =			
	1.000 *	1.000 *	42.451) +
	1.000 *	0.750 *	11.457) +
	1.000 *	0.962 *	1.368) + = 52.359
Qmax(2) =			
	0.831 *	1.000 *	42.451) +
	1.000 *	1.000 *	11.457) +
	0.851 *	1.000 *	1.368) + = 47.878
Qmax(3) =			
	0.976 *	1.000 *	42.451) +
	1.000 *	0.779 *	11.457) +
	1.000 *	1.000 *	1.368) + = 51.708

Total of 3 main streams to confluence:

Flow rates before confluence point:

42.451 11.457 1.368

Maximum flow rates at confluence using above data:

52.359 47.878 51.708

Area of streams before confluence:

35.170 10.820 1.010

Results of confluence:

Total flow rate = 52.359(CFS)

Time of concentration = 11.461 min.

Effective stream area after confluence = 47.000(Ac.)

End of computations, total study area = 47.000 (Ac.)

```
*****
*          *
*  FLOOD HYDROGRAPH PACKAGE (HEC-1)  *
*          JUN 1998   *
*          VERSION 4.1   *
*          *
*  RUN DATE 17FEB09 TIME 21:45:49  *
*          *
*****
```

```
*****
*          *
*  U.S. ARMY CORPS OF ENGINEERS   *
*  HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET   *
*          DAVIS, CALIFORNIA 95616   *
*          (916) 756-1104   *
*          *
*****
```

```
      X      X  XXXXXXXX  XXXXX      X
      X      X  X           X      X      XX
      X      X  X           X           X
  XXXXXXXX  XXXX      X      XXXXX  X
      X      X  X           X           X
      X      X  X           X      X      X
      X      X  XXXXXXXX  XXXXX      XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*DIAGRAM

*** FREE ***

```

1 ID TURVEY DG PIT
2 ID 100-YEAR DETENTION ANALYSIS FOR WESTERLY DRAINAGE AREA
3 ID RATIONAL METHOD HYDROGRAPH PROGRAM USED TO CONVERT RATIONAL METHOD
4 ID RESULTS TO A HYDROGRAPH
5 IO    1      2
6 IT    2 01JAN09    1200    200

7 KK BASIN
8 KM 6HR RAINFALL IS 3.0 INCHES
9 KM AVERAGE RATIONAL METHOD RUNOFF COEFFICIENT IS 0.27
10 KM RATIONAL METHOD TIME OF CONCENTRATION IS 15.28 MINUTES
11 BA .0169
12 IN 15 01JAN90    1153
13 QI   0     .5     .5     .6     .6     .6     .7     .7     .8     .8
14 QI   .9     1     1.1    1.3    1.5    2.3     3    11.5    1.8    1.2
15 QI   .9     .8     .7     .6     .6     0     0     0     0     0
16 QI   0     0     0     0     0     0     0     0     0     0

17 KK DETAIN
18 RS    1    STOR    -1
19 SV    0.    .001    0.314    0.314
20 SQ    0     1     1     5
21 SE 1308.9    1309    1314  1314.1
22 ZZ

```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT
 LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
 NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

```

7   BASIN
    V
    V
17  DETAIN

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****
*          *
*   FLOOD HYDROGRAPH PACKAGE (HEC-1)  *
*          JUN 1998
*          VERSION 4.1
*          *
*   RUN DATE 17FEB09 TIME 21:45:49  *
*          *
*****
```

```
*****
*          *
*   U.S. ARMY CORPS OF ENGINEERS  *
*   HYDROLOGIC ENGINEERING CENTER  *
*   609 SECOND STREET
*   DAVIS, CALIFORNIA 95616
*   (916) 756-1104
*          *
*****
```

TURVEY DG PIT
 100-YEAR DETENTION ANALYSIS FOR WESTERLY DRAINAGE AREA
 RATIONAL METHOD HYDROGRAPH PROGRAM USED TO CONVERT RATIONAL METHOD
 RESULTS TO A HYDROGRAPH

5 IO OUTPUT CONTROL VARIABLES
 IPRNT 1 PRINT CONTROL
 IPLOT 2 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA
 NMIN 2 MINUTES IN COMPUTATION INTERVAL
 IDATE 1JAN 9 STARTING DATE
 ITIME 1200 STARTING TIME
 NQ 200 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 1JAN 9 ENDING DATE
 NDTIME 1838 ENDING TIME
 ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .03 HOURS
 TOTAL TIME BASE 6.63 HOURS

ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRE-FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

```
*****
*          *
7 KK        *        BASIN    *
*          *
*****
```

6HR RAINFALL IS 3.0 INCHES
 AVERAGE RATIONAL METHOD RUNOFF COEFFICIENT IS 0.27
 RATIONAL METHOD TIME OF CONCENTRATION IS 15.28 MINUTES

12 IN TIME DATA FOR INPUT TIME SERIES
 JXMIN 15 TIME INTERVAL IN MINUTES
 JXDATE 1JAN90 STARTING DATE
 JXTIME 1153 STARTING TIME

SUBBASIN RUNOFF DATA

11 BA SUBBASIN CHARACTERISTICS
 TAREA .02 SUBBASIN AREA

HYDROGRAPH AT STATION BASIN

DA	MON	HRMN	ORD	*	DA	MON	HRMN	ORD	*	DA	MON	HRMN	ORD	*	DA	MON	HRMN	ORD	FLOW
				FLOW					*					FLOW					FLOW
1 JAN	1200	1	0.	*	1 JAN	1340	51	1.	*	1 JAN	1520	101	1.	*	1 JAN	1700	151	1.	.
1 JAN	1202	2	0.	*	1 JAN	1342	52	1.	*	1 JAN	1522	102	1.	*	1 JAN	1702	152	1.	.
1 JAN	1204	3	0.	*	1 JAN	1344	53	1.	*	1 JAN	1524	103	1.	*	1 JAN	1704	153	1.	.
1 JAN	1206	4	0.	*	1 JAN	1346	54	1.	*	1 JAN	1526	104	1.	*	1 JAN	1706	154	1.	.
1 JAN	1208	5	0.	*	1 JAN	1348	55	1.	*	1 JAN	1528	105	1.	*	1 JAN	1708	155	1.	.
1 JAN	1210	6	0.	*	1 JAN	1350	56	1.	*	1 JAN	1530	106	1.	*	1 JAN	1710	156	1.	.
1 JAN	1212	7	0.	*	1 JAN	1352	57	1.	*	1 JAN	1532	107	2.	*	1 JAN	1712	157	1.	.
1 JAN	1214	8	0.	*	1 JAN	1354	58	1.	*	1 JAN	1534	108	2.	*	1 JAN	1714	158	1.	.
1 JAN	1216	9	1.	*	1 JAN	1356	59	1.	*	1 JAN	1536	109	2.	*	1 JAN	1716	159	1.	.
1 JAN	1218	10	1.	*	1 JAN	1358	60	1.	*	1 JAN	1538	110	2.	*	1 JAN	1718	160	1.	.
1 JAN	1220	11	1.	*	1 JAN	1400	61	1.	*	1 JAN	1540	111	2.	*	1 JAN	1720	161	1.	.
1 JAN	1222	12	1.	*	1 JAN	1402	62	1.	*	1 JAN	1542	112	2.	*	1 JAN	1722	162	1.	.
1 JAN	1224	13	1.	*	1 JAN	1404	63	1.	*	1 JAN	1544	113	2.	*	1 JAN	1724	163	1.	.
1 JAN	1226	14	1.	*	1 JAN	1406	64	1.	*	1 JAN	1546	114	2.	*	1 JAN	1726	164	1.	.
1 JAN	1228	15	1.	*	1 JAN	1408	65	1.	*	1 JAN	1548	115	2.	*	1 JAN	1728	165	1.	.
1 JAN	1230	16	1.	*	1 JAN	1410	66	1.	*	1 JAN	1550	116	2.	*	1 JAN	1730	166	1.	.
1 JAN	1232	17	1.	*	1 JAN	1412	67	1.	*	1 JAN	1552	117	3.	*	1 JAN	1732	167	1.	.
1 JAN	1234	18	1.	*	1 JAN	1414	68	1.	*	1 JAN	1554	118	3.	*	1 JAN	1734	168	1.	.
1 JAN	1236	19	1.	*	1 JAN	1416	69	1.	*	1 JAN	1556	119	3.	*	1 JAN	1736	169	1.	.
1 JAN	1238	20	1.	*	1 JAN	1418	70	1.	*	1 JAN	1558	120	3.	*	1 JAN	1738	170	1.	.
1 JAN	1240	21	1.	*	1 JAN	1420	71	1.	*	1 JAN	1600	121	3.	*	1 JAN	1740	171	1.	.
1 JAN	1242	22	1.	*	1 JAN	1422	72	1.	*	1 JAN	1602	122	4.	*	1 JAN	1742	172	1.	.
1 JAN	1244	23	1.	*	1 JAN	1424	73	1.	*	1 JAN	1604	123	5.	*	1 JAN	1744	173	1.	.
1 JAN	1246	24	1.	*	1 JAN	1426	74	1.	*	1 JAN	1606	124	6.	*	1 JAN	1746	174	1.	.
1 JAN	1248	25	1.	*	1 JAN	1428	75	1.	*	1 JAN	1608	125	7.	*	1 JAN	1748	175	1.	.
1 JAN	1250	26	1.	*	1 JAN	1430	76	1.	*	1 JAN	1610	126	8.	*	1 JAN	1750	176	1.	.
1 JAN	1252	27	1.	*	1 JAN	1432	77	1.	*	1 JAN	1612	127	9.	*	1 JAN	1752	177	1.	.
1 JAN	1254	28	1.	*	1 JAN	1434	78	1.	*	1 JAN	1614	128	10.	*	1 JAN	1754	178	1.	.
1 JAN	1256	29	1.	*	1 JAN	1436	79	1.	*	1 JAN	1616	129	12.	*	1 JAN	1756	179	1.	.
1 JAN	1258	30	1.	*	1 JAN	1438	80	1.	*	1 JAN	1618	130	10.	*	1 JAN	1758	180	1.	.
1 JAN	1300	31	1.	*	1 JAN	1440	81	1.	*	1 JAN	1620	131	9.	*	1 JAN	1800	181	1.	.
1 JAN	1302	32	1.	*	1 JAN	1442	82	1.	*	1 JAN	1622	132	8.	*	1 JAN	1802	182	1.	.
1 JAN	1304	33	1.	*	1 JAN	1444	83	1.	*	1 JAN	1624	133	6.	*	1 JAN	1804	183	0.	.
1 JAN	1306	34	1.	*	1 JAN	1446	84	1.	*	1 JAN	1626	134	5.	*	1 JAN	1806	184	0.	.
1 JAN	1308	35	1.	*	1 JAN	1448	85	1.	*	1 JAN	1628	135	4.	*	1 JAN	1808	185	0.	.
1 JAN	1310	36	1.	*	1 JAN	1450	86	1.	*	1 JAN	1630	136	2.	*	1 JAN	1810	186	0.	.
1 JAN	1312	37	1.	*	1 JAN	1452	87	1.	*	1 JAN	1632	137	2.	*	1 JAN	1812	187	0.	.
1 JAN	1314	38	1.	*	1 JAN	1454	88	1.	*	1 JAN	1634	138	2.	*	1 JAN	1814	188	0.	.
1 JAN	1316	39	1.	*	1 JAN	1456	89	1.	*	1 JAN	1636	139	2.	*	1 JAN	1816	189	0.	.
1 JAN	1318	40	1.	*	1 JAN	1458	90	1.	*	1 JAN	1638	140	2.	*	1 JAN	1818	190	0.	.
1 JAN	1320	41	1.	*	1 JAN	1500	91	1.	*	1 JAN	1640	141	1.	*	1 JAN	1820	191	0.	.
1 JAN	1322	42	1.	*	1 JAN	1502	92	1.	*	1 JAN	1642	142	1.	*	1 JAN	1822	192	0.	.
1 JAN	1324	43	1.	*	1 JAN	1504	93	1.	*	1 JAN	1644	143	1.	*	1 JAN	1824	193	0.	.
1 JAN	1326	44	1.	*	1 JAN	1506	94	1.	*	1 JAN	1646	144	1.	*	1 JAN	1826	194	0.	.
1 JAN	1328	45	1.	*	1 JAN	1508	95	1.	*	1 JAN	1648	145	1.	*	1 JAN	1828	195	0.	.
1 JAN	1330	46	1.	*	1 JAN	1510	96	1.	*	1 JAN	1650	146	1.	*	1 JAN	1830	196	0.	.
1 JAN	1332	47	1.	*	1 JAN	1512	97	1.	*	1 JAN	1652	147	1.	*	1 JAN	1832	197	0.	.
1 JAN	1334	48	1.	*	1 JAN	1514	98	1.	*	1 JAN	1654	148	1.	*	1 JAN	1834	198	0.	.
1 JAN	1336	49	1.	*	1 JAN	1516	99	1.	*	1 JAN	1656	149	1.	*	1 JAN	1836	199	0.	.
1 JAN	1338	50	1.	*	1 JAN	1518	100	1.	*	1 JAN	1658	150	1.	*	1 JAN	1838	200	0.	.
			*	*					*				*					*	

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	6.63-HR
+ (CFS)	(HR)	(CFS)			
+ 12.	4.27	1.	1.	1.	1.
		(INCHES)	.800	.803	.803
		(AC-FT)	1.	1.	1.

CUMULATIVE AREA = .02 SQ MI

STATION BASIN

11634	138.	0.
11636	139.	0.
11638	140.	0.
11640	141.	0.
11642	142.	0.
11644	143.	0.
11646	144.	0.
11648	145.	0.
11650	146.	0.
11652	147.	0.
11654	148.	0.
11656	149.	0.
11658	150.	0.
11700	151.	0.
11702	152.	0.
11704	153.	0.
11706	154.	0.
11708	155.	0.
11710	156.	0.
11712	157.	0.
11714	158.	0.
11716	159.	0.
11718	160.	0.
11720	161.	0.
11722	162.	0.
11724	163.	0.
11726	164.	0.
11728	165.	0.
11730	166.	0.
11732	167.	0.
11734	168.	0.
11736	169.	0.
11738	170.	0.
11740	171.	0.
11742	172.	0.
11744	173.	0.
11746	174.	0.
11748	175.	0.
11750	176.	0.
11752	177.	0.
11754	178.	0.
11756	179.	0.
11758	180.	0.
11800	181.	0.
11802	182.	0.
11804	183.	0.
11806	184.	0.
11808	185.	0.
11810	186.	0.
11812	187.	0.
11814	188.	0.
11816	189.	0.
11818	190.	0.
11820	191.	0.
11822	192.	0.
11824	193.	0.
11826	194.	0.
11828	195.	0.
11830	196.	0.
11832	197.	0.
11834	198.	0.
11836	199.	0.
11838	200.	0.

* * *****
17 KK * DETAIN *
* * *****

HYDROGRAPH ROUTING DATA

18 RS	STORAGE ROUTING				
	NSTPS	1	NUMBER OF SUBREACHES		
	ITYP	STOR	TYPE OF INITIAL CONDITION		
	RSVRIC	-1.00	INITIAL CONDITION		
	X	.00	WORKING R AND D COEFFICIENT		
19 SV	STORAGE	.0	.0	.3	.3
20 SQ	DISCHARGE	0.	1.	1.	5.
21 SE	ELEVATION	1308.90	1309.00	1314.00	1314.10

* * *

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 1.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

HYDROGRAPH AT STATION DETAIN

DA	MON	HRMN	ORD	*				*				*										
				OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	JAN	1200	1	0.	.0	1308.9	*	1	JAN	1414	68	1.	.0	1309.0	*	1	JAN	1628	135	1.	.3	1313.9
1	JAN	1202	2	0.	.0	1308.9	*	1	JAN	1416	69	1.	.0	1309.0	*	1	JAN	1630	136	1.	.3	1314.0
1	JAN	1204	3	0.	.0	1308.9	*	1	JAN	1418	70	1.	.0	1309.0	*	1	JAN	1632	137	2.	.3	1314.0
1	JAN	1206	4	0.	.0	1308.9	*	1	JAN	1420	71	1.	.0	1309.0	*	1	JAN	1634	138	2.	.3	1314.0
1	JAN	1208	5	0.	.0	1308.9	*	1	JAN	1422	72	1.	.0	1309.0	*	1	JAN	1636	139	2.	.3	1314.0
1	JAN	1210	6	0.	.0	1308.9	*	1	JAN	1424	73	1.	.0	1309.0	*	1	JAN	1638	140	2.	.3	1314.0
1	JAN	1212	7	0.	.0	1308.9	*	1	JAN	1426	74	1.	.0	1309.0	*	1	JAN	1640	141	1.	.3	1314.0
1	JAN	1214	8	0.	.0	1308.9	*	1	JAN	1428	75	1.	.0	1309.0	*	1	JAN	1642	142	1.	.3	1314.0
1	JAN	1216	9	0.	.0	1308.9	*	1	JAN	1430	76	1.	.0	1309.0	*	1	JAN	1644	143	1.	.3	1314.0
1	JAN	1218	10	1.	.0	1309.0	*	1	JAN	1432	77	1.	.0	1309.0	*	1	JAN	1646	144	1.	.3	1314.0
1	JAN	1220	11	0.	.0	1308.9	*	1	JAN	1434	78	1.	.0	1309.0	*	1	JAN	1648	145	1.	.3	1314.0
1	JAN	1222	12	1.	.0	1309.0	*	1	JAN	1436	79	1.	.0	1309.0	*	1	JAN	1650	146	1.	.3	1314.0
1	JAN	1224	13	0.	.0	1308.9	*	1	JAN	1438	80	1.	.0	1309.0	*	1	JAN	1652	147	1.	.3	1314.0
1	JAN	1226	14	1.	.0	1309.0	*	1	JAN	1440	81	1.	.0	1309.0	*	1	JAN	1654	148	1.	.3	1314.0
1	JAN	1228	15	0.	.0	1308.9	*	1	JAN	1442	82	1.	.0	1309.0	*	1	JAN	1656	149	1.	.3	1314.0
1	JAN	1230	16	1.	.0	1309.0	*	1	JAN	1444	83	1.	.0	1309.0	*	1	JAN	1658	150	1.	.3	1314.0
1	JAN	1232	17	1.	.0	1309.0	*	1	JAN	1446	84	1.	.0	1309.0	*	1	JAN	1700	151	1.	.3	1314.0
1	JAN	1234	18	1.	.0	1309.0	*	1	JAN	1448	85	1.	.0	1309.0	*	1	JAN	1702	152	1.	.3	1314.0
1	JAN	1236	19	1.	.0	1309.0	*	1	JAN	1450	86	1.	.0	1309.0	*	1	JAN	1704	153	1.	.3	1314.0
1	JAN	1238	20	1.	.0	1309.0	*	1	JAN	1452	87	1.	.0	1309.0	*	1	JAN	1706	154	1.	.3	1314.0
1	JAN	1240	21	1.	.0	1309.0	*	1	JAN	1454	88	1.	.0	1309.0	*	1	JAN	1708	155	1.	.3	1314.0
1	JAN	1242	22	1.	.0	1309.0	*	1	JAN	1456	89	1.	.0	1309.0	*	1	JAN	1710	156	1.	.3	1314.0
1	JAN	1244	23	1.	.0	1309.0	*	1	JAN	1458	90	1.	.0	1309.0	*	1	JAN	1712	157	1.	.3	1314.0
1	JAN	1246	24	1.	.0	1309.0	*	1	JAN	1500	91	1.	.0	1309.0	*	1	JAN	1714	158	1.	.3	1314.0
1	JAN	1248	25	1.	.0	1309.0	*	1	JAN	1502	92	1.	.0	1309.0	*	1	JAN	1716	159	1.	.3	1314.0
1	JAN	1250	26	1.	.0	1309.0	*	1	JAN	1504	93	1.	.0	1309.0	*	1	JAN	1718	160	1.	.3	1313.9
1	JAN	1252	27	1.	.0	1309.0	*	1	JAN	1506	94	1.	.0	1309.0	*	1	JAN	1720	161	1.	.3	1313.9
1	JAN	1254	28	1.	.0	1309.0	*	1	JAN	1508	95	1.	.0	1309.0	*	1	JAN	1722	162	1.	.3	1313.9
1	JAN	1256	29	1.	.0	1309.0	*	1	JAN	1510	96	1.	.0	1309.0	*	1	JAN	1724	163	1.	.3	1313.9
1	JAN	1258	30	1.	.0	1309.0	*	1	JAN	1512	97	1.	.0	1309.1	*	1	JAN	1726	164	1.	.3	1313.9

1 JAN 1300	31	1.	.0	1309.0 *	1 JAN 1514	98	1.	.0	1309.1 *	1 JAN 1728	165	1.	.3	1313.9
1 JAN 1302	32	1.	.0	1309.0 *	1 JAN 1516	99	1.	.0	1309.1 *	1 JAN 1730	166	1.	.3	1313.9
1 JAN 1304	33	1.	.0	1309.0 *	1 JAN 1518	100	1.	.0	1309.1 *	1 JAN 1732	167	1.	.3	1313.9
1 JAN 1306	34	1.	.0	1309.0 *	1 JAN 1520	101	1.	.0	1309.1 *	1 JAN 1734	168	1.	.3	1313.9
1 JAN 1308	35	1.	.0	1309.0 *	1 JAN 1522	102	1.	.0	1309.1 *	1 JAN 1736	169	1.	.3	1313.8
1 JAN 1310	36	1.	.0	1309.0 *	1 JAN 1524	103	1.	.0	1309.1 *	1 JAN 1738	170	1.	.3	1313.8
1 JAN 1312	37	1.	.0	1309.0 *	1 JAN 1526	104	1.	.0	1309.2 *	1 JAN 1740	171	1.	.3	1313.8
1 JAN 1314	38	1.	.0	1309.0 *	1 JAN 1528	105	1.	.0	1309.2 *	1 JAN 1742	172	1.	.3	1313.8
1 JAN 1316	39	1.	.0	1309.0 *	1 JAN 1530	106	1.	.0	1309.2 *	1 JAN 1744	173	1.	.3	1313.8
1 JAN 1318	40	1.	.0	1309.0 *	1 JAN 1532	107	1.	.0	1309.2 *	1 JAN 1746	174	1.	.3	1313.8
1 JAN 1320	41	1.	.0	1309.0 *	1 JAN 1534	108	1.	.0	1309.3 *	1 JAN 1748	175	1.	.3	1313.7
1 JAN 1322	42	1.	.0	1309.0 *	1 JAN 1536	109	1.	.0	1309.3 *	1 JAN 1750	176	1.	.3	1313.7
1 JAN 1324	43	1.	.0	1309.0 *	1 JAN 1538	110	1.	.0	1309.3 *	1 JAN 1752	177	1.	.3	1313.7
1 JAN 1326	44	1.	.0	1309.0 *	1 JAN 1540	111	1.	.0	1309.4 *	1 JAN 1754	178	1.	.3	1313.7
1 JAN 1328	45	1.	.0	1309.0 *	1 JAN 1542	112	1.	.0	1309.4 *	1 JAN 1756	179	1.	.3	1313.7
1 JAN 1330	46	1.	.0	1309.0 *	1 JAN 1544	113	1.	.0	1309.5 *	1 JAN 1758	180	1.	.3	1313.7
1 JAN 1332	47	1.	.0	1309.0 *	1 JAN 1546	114	1.	.0	1309.5 *	1 JAN 1800	181	1.	.3	1313.6
1 JAN 1334	48	1.	.0	1309.0 *	1 JAN 1548	115	1.	.0	1309.6 *	1 JAN 1802	182	1.	.3	1313.6
1 JAN 1336	49	1.	.0	1309.0 *	1 JAN 1550	116	1.	.0	1309.6 *	1 JAN 1804	183	1.	.3	1313.6
1 JAN 1338	50	1.	.0	1309.0 *	1 JAN 1552	117	1.	.0	1309.7 *	1 JAN 1806	184	1.	.3	1313.6
1 JAN 1340	51	1.	.0	1309.0 *	1 JAN 1554	118	1.	.0	1309.8 *	1 JAN 1808	185	1.	.3	1313.5
1 JAN 1342	52	1.	.0	1309.0 *	1 JAN 1556	119	1.	.1	1309.8 *	1 JAN 1810	186	1.	.3	1313.5
1 JAN 1344	53	1.	.0	1309.0 *	1 JAN 1558	120	1.	.1	1309.9 *	1 JAN 1812	187	1.	.3	1313.5
1 JAN 1346	54	1.	.0	1309.0 *	1 JAN 1600	121	1.	.1	1310.0 *	1 JAN 1814	188	1.	.3	1313.4
1 JAN 1348	55	1.	.0	1309.0 *	1 JAN 1602	122	1.	.1	1310.1 *	1 JAN 1816	189	1.	.3	1313.4
1 JAN 1350	56	1.	.0	1309.0 *	1 JAN 1604	123	1.	.1	1310.3 *	1 JAN 1818	190	1.	.3	1313.4
1 JAN 1352	57	1.	.0	1309.0 *	1 JAN 1606	124	1.	.1	1310.4 *	1 JAN 1820	191	1.	.3	1313.3
1 JAN 1354	58	1.	.0	1309.0 *	1 JAN 1608	125	1.	.1	1310.7 *	1 JAN 1822	192	1.	.3	1313.3
1 JAN 1356	59	1.	.0	1309.0 *	1 JAN 1610	126	1.	.1	1311.0 *	1 JAN 1824	193	1.	.3	1313.2
1 JAN 1358	60	1.	.0	1309.0 *	1 JAN 1612	127	1.	.1	1311.3 *	1 JAN 1826	194	1.	.3	1313.2
1 JAN 1400	61	1.	.0	1309.0 *	1 JAN 1614	128	1.	.2	1311.7 *	1 JAN 1828	195	1.	.3	1313.1
1 JAN 1402	62	1.	.0	1309.0 *	1 JAN 1616	129	1.	.2	1312.1 *	1 JAN 1830	196	1.	.3	1313.1
1 JAN 1404	63	1.	.0	1309.0 *	1 JAN 1618	130	1.	.2	1312.6 *	1 JAN 1832	197	1.	.3	1313.0
1 JAN 1406	64	1.	.0	1309.0 *	1 JAN 1620	131	1.	.2	1312.9 *	1 JAN 1834	198	1.	.3	1313.0
1 JAN 1408	65	1.	.0	1309.0 *	1 JAN 1622	132	1.	.3	1313.3 *	1 JAN 1836	199	1.	.2	1313.0
1 JAN 1410	66	1.	.0	1309.0 *	1 JAN 1624	133	1.	.3	1313.5 *	1 JAN 1838	200	1.	.2	1312.9
1 JAN 1412	67	1.	.0	1309.0 *	1 JAN 1626	134	1.	.3	1313.7 *					

*

PEAK FLOW + (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW				6.63-HR
		6-HR	24-HR	72-HR		
+ 2.	4.53	1.	1.	1.	1.	
		(INCHES)	.508	.530	.530	
		(AC-FT)	0.	0.	0.	
PEAK STORAGE + (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE				6.63-HR
0.	4.53	0.	0.	0.	0.	
PEAK STAGE + (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE				6.63-HR
1314.02	4.53	1310.97	1310.78	1310.78	1310.78	

CUMULATIVE AREA = .02 SQ MI

		STATION		DETAIN									
		(I)	INFLOW,	(O)	OUTFLOW								
		-2.	0.	2.	4.	6.	8.	10.	12.	0.	0.	0.	0.
		.0	.0	.0	.0	.0	.0	.0	.1	.2	.3	.4	.0
		DAHRMN PER							(S)	STORAGE			
11200	1.	-	I-	-	-	-	-	-	S-	-	-	-	-
11202	2.	.	I	.	.	.	.	.	S	.	.	.	.
11204	3.	.	I	.	.	.	.	.	S	.	.	.	.
11206	4.	.	I	.	.	.	.	.	S	.	.	.	.
11208	5.	.	I	.	.	.	.	.	S	.	.	.	.
11210	6.	.	I	.	.	.	.	.	S	.	.	.	.
11212	7.	.	I	.	.	.	.	.	S	.	.	.	.
11214	8.	.	I	.	.	.	.	.	S	.	.	.	.
11216	9.	.	I	.	.	.	.	.	S	.	.	.	.
11218	10.	.	IO	.	.	.	.	.	S	.	.	.	.
11220	11.	.	-	I	.	.	.	.	S	.	.	.	.
11222	12.	.	IO	.	.	.	.	.	S	.	.	.	.
11224	13.	.	I	.	.	.	.	.	S	.	.	.	.
11226	14.	.	IO	.	.	.	.	.	S	.	.	.	.
11228	15.	.	I	.	.	.	.	.	S	.	.	.	.
11230	16.	.	IO	.	.	.	.	.	S	.	.	.	.
11232	17.	.	I	.	.	.	.	.	S	.	.	.	.
11234	18.	.	I	.	.	.	.	.	S	.	.	.	.
11236	19.	.	I	.	.	.	.	.	S	.	.	.	.
11238	20.	.	I	.	.	.	.	.	S	.	.	.	.
11240	21.	.	-	I	.	.	.	.	S	.	.	.	.
11242	22.	.	I	.	.	.	.	.	S	.	.	.	.
11244	23.	.	I	.	.	.	.	.	S	.	.	.	.
11246	24.	.	I	.	.	.	.	.	S	.	.	.	.
11248	25.	.	I	.	.	.	.	.	S	.	.	.	.
11250	26.	.	I	.	.	.	.	.	S	.	.	.	.
11252	27.	.	I	.	.	.	.	.	S	.	.	.	.
11254	28.	.	I	.	.	.	.	.	S	.	.	.	.
11256	29.	.	I	.	.	.	.	.	S	.	.	.	.
11258	30.	.	I	.	.	.	.	.	S	.	.	.	.
11300	31.	.	-	I	.	.	.	.	S	.	.	.	.
11302	32.	.	I	.	.	.	.	.	S	.	.	.	.
11304	33.	.	I	.	.	.	.	.	S	.	.	.	.
11306	34.	.	I	.	.	.	.	.	S	.	.	.	.
11308	35.	.	I	.	.	.	.	.	S	.	.	.	.
11310	36.	.	I	.	.	.	.	.	S	.	.	.	.
11312	37.	.	I	.	.	.	.	.	S	.	.	.	.
11314	38.	.	I	.	.	.	.	.	S	.	.	.	.
11316	39.	.	I	.	.	.	.	.	S	.	.	.	.
11318	40.	.	I	.	.	.	.	.	S	.	.	.	.
11320	41.	.	-	I	.	.	.	.	S	.	.	.	.
11322	42.	.	I	.	.	.	.	.	S	.	.	.	.
11324	43.	.	I	.	.	.	.	.	S	.	.	.	.
11326	44.	.	I	.	.	.	.	.	S	.	.	.	.
11328	45.	.	I	.	.	.	.	.	S	.	.	.	.
11330	46.	.	I	.	.	.	.	.	S	.	.	.	.
11332	47.	.	I	.	.	.	.	.	S	.	.	.	.
11334	48.	.	IO	.	.	.	.	.	S	.	.	.	.
11336	49.	.	I	.	.	.	.	.	S	.	.	.	.
11338	50.	.	IO	.	.	.	.	.	S	.	.	.	.
11340	51.	.	-	I	.	.	.	.	S	.	.	.	.
11342	52.	.	IO	.	.	.	.	.	S	.	.	.	.
11344	53.	.	I	.	.	.	.	.	S	.	.	.	.
11346	54.	.	I	.	.	.	.	.	S	.	.	.	.
11348	55.	.	I	.	.	.	.	.	S	.	.	.	.
11350	56.	.	I	.	.	.	.	.	S	.	.	.	.
11352	57.	.	I	.	.	.	.	.	S	.	.	.	.
11354	58.	.	I	.	.	.	.	.	S	.	.	.	.
11356	59.	.	I	.	.	.	.	.	S	.	.	.	.
11358	60.	.	I	.	.	.	.	.	S	.	.	.	.
11400	61.	.	-	I	.	.	.	.	S	.	.	.	.
11402	62.	.	I	.	.	.	.	.	S	.	.	.	.
11404	63.	.	I	.	.	.	.	.	S	.	.	.	.
11406	64.	.	I	.	.	.	.	.	S	.	.	.	.

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

+	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
					6-HOUR	24-HOUR	72-HOUR			
+	HYDROGRAPH AT	BASIN	12.	4.27	1.	1.	1.	.02		
+	ROUTED TO	DETAIN	2.	4.53	1.	1.	1.	.02	1314.02	4.53

*** NORMAL END OF HEC-1 ***